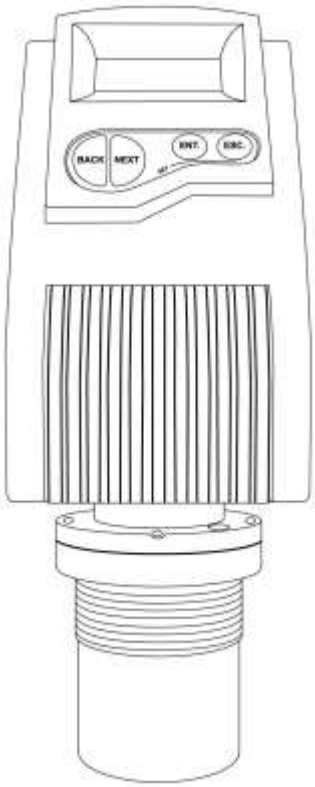
MonoScan
User's Manual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Date	Revision	Software Version	Catalog Number
Feb. 2014	1.31	4.090 English	680001E

Safety Guidelines

- MonoScan must be installed, connected and operated according to the instructions in this Manual.
- Installation in hazardous area should be according to this manual and relevant control drawings. For more information consult with your distributor.
- If installed incorrectly or used for applications for which it is not intended, application-related dangers may arise.
- Only qualified personnel are authorized to install and operate MonoScan.
- Do not open the MonoScan unit. If the unit is opened, the warranty is null and void.
- Modifications and repairs to MonoScan are permissible only when the manufacturer expressly approves them.

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Chapter 1

Introducing MonoScan

MonoScan is an ultrasonic, continuous-level measurement gauge of mono-block construction (combining the sensor and electronic components in a single unit). MonoScan measures the height of both liquids and solids accurately.

It can be used for the following measurement tasks:

- Liquid tanks with calm surfaces
- Solids tanks that are dust-free
- Open channel flow measurement

MonoScan has a range of up to 15 m (49.21 ft) with an accuracy of 0.25% of the maximum measuring range.

The following diagrams show the front and side views of MonoScan, and its dimensions:

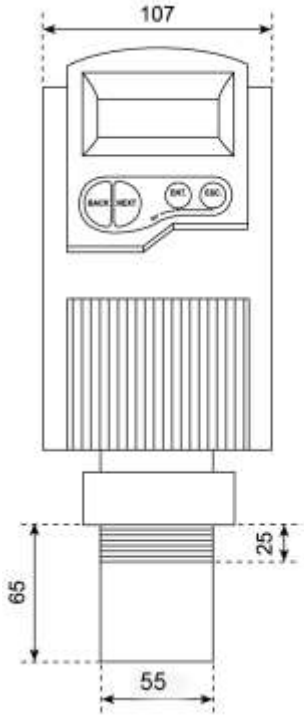


Figure 1: Front View of MonoScan

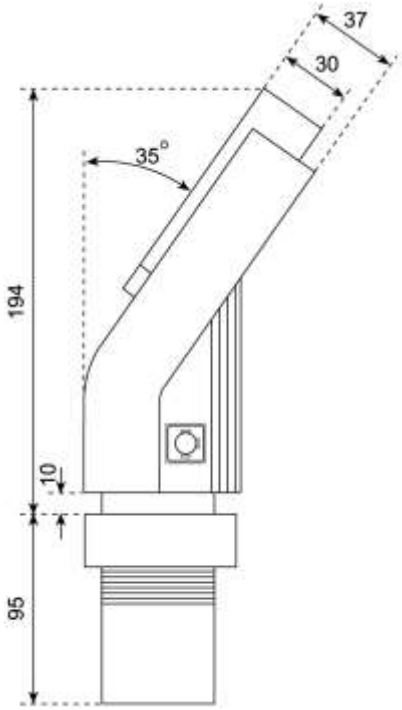


Figure 2: Side View of MonoScan

MonoScan Specifications

Accuracy	0.25% of max range (1cm max [short]) (3.5cm max [std])
Resolution	1 mm (0.04")
Beam angle	5° @ 3db point
Ambient temperature compensation	Automatic

Measuring Ranges

MonoScan L for liquids	Short Range	0.25 m – 5 m 0.82 ft – 16.4 ft
	Standard	0.6 m – 15 m 1.96 ft – 49.2 ft
MonoScan S for solids	Short Range	0.25 m – 3.5 m 0.82 ft – 16.4 ft
	Standard	0.6 m – 8.5 m 1.96 ft – 27.8 ft
MonoScan O for open channels	Short Range	0.25 m – 5 m 0.82 ft – 16.4 ft
	Standard	0.6 m – 15 m 1.96 ft – 49.2 ft

Mechanical Specifications

Enclosure	IP 65, Mono-block construction. Plastic enclosure: ABS+UV
Pollution degree	2 (as per IEC61010)
Insulation category	II (as per IEC61010)
Wetted parts	Sensor body: Polypropylene, PVDF, Coated aluminum (ECTFE).
Operating temperature	-40° C to + 70° C (-40° F to +158° F)
Mounting	2" BSP or 2" NPT
Operating pressure	0.9 - 2 bar
Dimensions	289 x 107 x 85 mm (11.38 x 4.21 x 3.35")
Weight	Up to 1.4 kg (3.08 lb)

Electrical Specifications

Display	Integral LCD, four digits.
Loop current	4 – 20 mA, 727 Ω @ 28 VDC
Supply	At least 12.0 VDC on terminals. Recomended: 15-28VDC (CE certified)
Certificates	CE – EMC, FCC. ATEX: EEX ia IIC T4 NEPSI: Ex ia IIC T4

Chapter 2

Installing MonoScan

Precautions

- Φ Ensure that MonoScan is mounted in an area that meets the stated temperature, pressure and technical specifications.
- Φ Ensure that high-voltage sources or cables are at least 1 m away from the sensor and its cable.
- Φ Use round cables with minimum diameter of 6 - 7 mm to ensure that the unit remains sealed, IP 65.
- Φ Ensure that cables are routed correctly and tightened along walls or pipes.
- Φ Installation and operation of this product should be performed, according to the Product User Manual and Product Certification. Otherwise the use of this product is prohibited.

Installing MonoScan

When installing MonoScan, ensure that it is:

Φ Mounted above the dead-zone area.

NOTE:

If the device enters the blocking distance (dead zone), it will not measure correctly.

Φ Positioned at least 0.5 m (1.64 ft) away from the tank walls. Add 10 Cm (4") spacing for each 1m (40") in range.

Φ Perpendicular to the surface of the target.

NOTE:

Even the slightest difference in angle may affect echo quality.

Φ Placed as far as possible from noisy areas, such as a filling inlet.

NOTE:

When installed in a humid environment it is recommended to position the sensor on a tripod on top of the vessel.

Installing MonoScan on Threaded Flange/Thread-Free Flange

MonoScan is available in two thread types, 2" BSP or 2" NPT.

MonoScan can be installed with threaded-flange mounting or with thread-free flange mounting, as shown below:

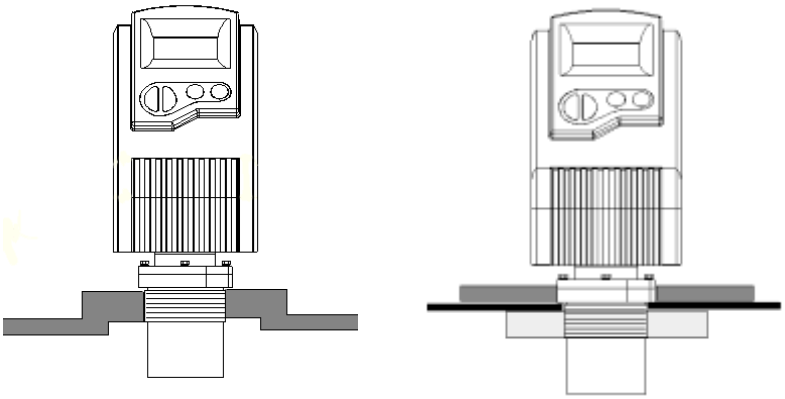


Figure 3: Threaded Flange/Thread-Free Flange Mounting

NOTES:

When installing a thread-free flange mounted unit, you will need a 2" locking nut to secure the unit inside the tank.

When installing a threaded flange, ensure that it matches the MonoScan threads.

➢ To install MonoScan:

1 Insert the threaded end of MonoScan into the aperture at the top of the tank or pipe.

2 Bolt MonoScan into place in one of the following ways:

- Φ **Threaded-flange mounting:** Screw the unit into a flange with a threaded 2" hole.
- Φ **Thread-free mounting:** Place MonoScan in the flange, and bolt it from within the tank with a 2" locking nut.

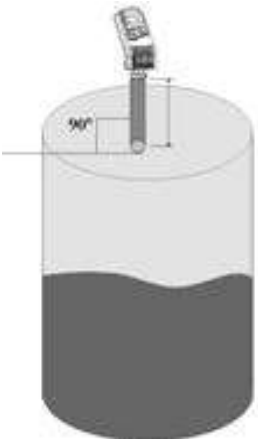
NOTE:

Tighten the nut by hand only. When tightening the nut, hold the lower part of the MonoScan unit. Make sure that the seal is leak proof.

Installing MonoScan via Extension Pipes

If the level of the measured surface falls within the dead-zone area, you should use an extension pipe to mount MonoScan.

When using an extension pipe, ensure that:



- The sensor is positioned in the center of the pipe.
- The pipe extension is exactly perpendicular to the surface of the target.
- The internal pipe diameter is at least 3.0" wide.
- The pipe is preferably made of plastic and must have a smooth interior surface.
- The pipe should not protrude inside the tank.
- The tank drilling should be at least in size of the internal pipe diameter and with smooth edge.

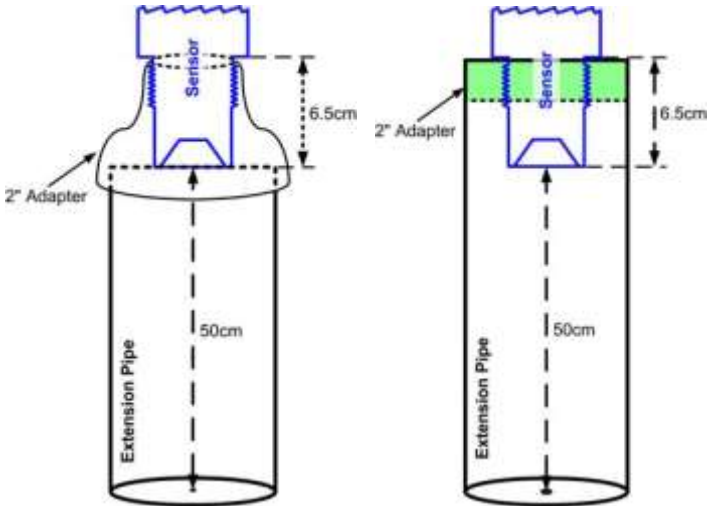
When installing the MonoScan with extension pipes, follow these specifications:

Pipe Length*	Internal Pipe Diameter
0.5 m (1.64ft)	>3.0"

* Note: Measured from the sensor's lower edge.

NOTE:

1. It is always recommended to use interference signal feature (Pr.03) to locate interfering signals when using an extension pipe.
2. The sensor's lower edge may be a) aligned with the extension pipe's upper edge or b) protrude it by up to 6.5 cm. See Figure 4 below.



a) b)

Figure No.4: Extension Pipe Recommendations

Connecting the MonoScan to a Power Cable

Using a PG7 connector

1. Remove the retaining screw from the electrical connector.
2. Remove the male part from the MonoScan unit.
3. Separate the plastic electrical connector shell from the wiring block.
4. Connect the +24V wire to Terminal 1, connect the -24V wire to Terminal 2 on the Wiring Block.
5. Snap the electrical connector wiring block back into the electrical connector shell.
6. Pull the electrical connector to the MonoScan socket plug and fasten with the retaining screw provided.

Figure 5: MonoScan Connector Front View

NOTE:
The cable for the mating connector must be at least 6 mm in diameter.

Using a conduit

1. Remove the four retaining screws from the conduit adapter cover.
2. Pull the electrical wires through the 1/2" NPT/ M20 conduit connection.
3. Connect the -24V wire to Terminal 1, connect the +24V wire to Terminal 2 on the Wiring Block.
4. Return the adapter's cover to its place properly. Make sure that the O-ring is placed correctly. Fasten the four retaining screws.

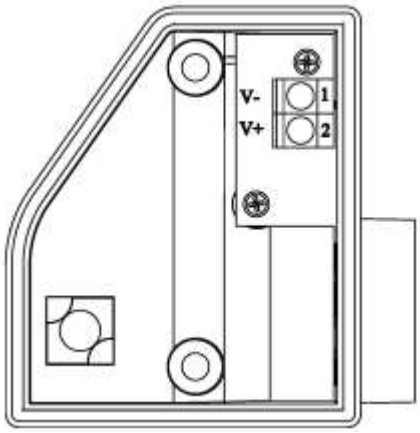


Figure 6: MonoScan Conduit Adapter

NOTE:

The conduit adapter should not exceed a torque of 50 lb/In.

To maintain the MonoScan properly sealed, make sure that conduit is firmly screwed to the conduit's adaptor.

Non-Intrinsically Safe Connections

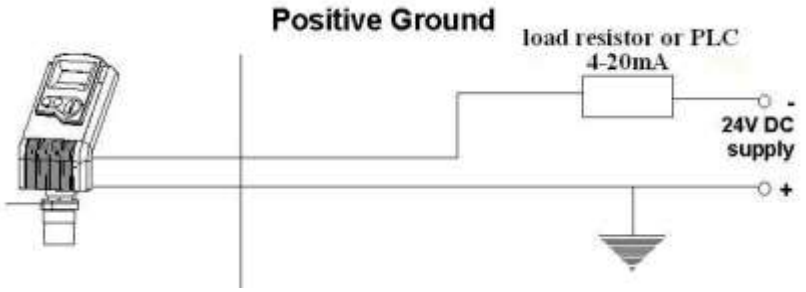


Figure 7: Non-Intrinsically Safe Positive Ground Connection

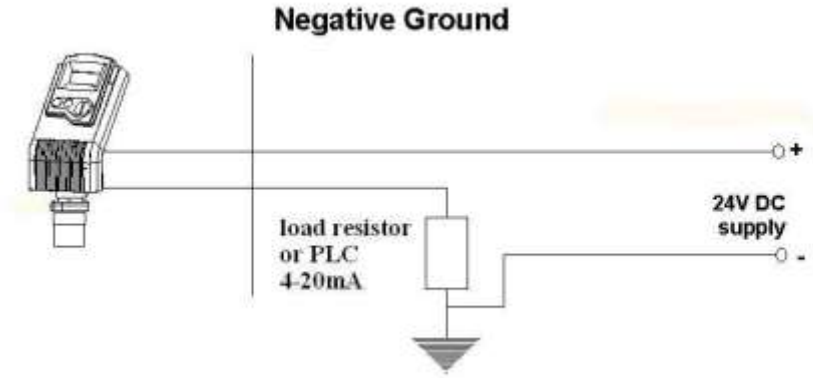


Figure 8: Non-Intrinsically Safe Negative Ground Connection

Power Supply and Load Resistance Recommendations

The following table specifies the recommended resistance* range for each power supply voltage (Non-Intrinsically Safe).

Power Supply Voltage	Minimum Resistance Value	Maximum Resistance Value
15 V	0 Ω	136 Ω
18 V	0 Ω	272 Ω
24 V	41 Ω	545 Ω
28 V	68 Ω	727 Ω

*Note: The resistance value is the total sum of the series resistor (or PLC resistance) and the lines resistance. The minimum voltage level on terminals should be not less than 120 VDC.

Ripple/Noise Parameters Recommended for the Power Supply

The following ripple/noise parameters are recommended for the power supply:

Φ 100 mvp-p max

Power Supply types recommendations

- Prefer a regulated switching power supply.
- A rectified power supply is not recommended.
- When powering by a battery, avoid the using of switched charger.

Feeding Via PLC

- Verify that the voltage level on the MonoScan terminals is at least 12.0 VDC.
- Check PLC specifications for grounding options.
- It is good practice to add 150 Ohm series resistor between MonoScan positive terminal and PLC.

Intrinsically Safe Connections

Hazardous Area Installation

(For Ex version)

Installation of the equipment shall be in accordance with the NEC Articles 504 and 505 and ISA RP 12.06.01 Recommended Practice for the Installation of Intrinsically Safe Circuits.

Instructions specific to hazardous area installation.

(Reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)

The following instructions apply to equipment covered by certificate number Sira 03ATEX2134X:

Remark: The certificate number has an 'X' suffix, to indicate a special certification condition which does not apply to the MonoScan.

- Φ The equipment may be used in a hazardous area with flammable gases and vapors with Apparatus Groups IIC, IIB and IIA and with temperature classes T1, T2, T3 and T4.
- Φ The equipment is certified for use in ambient temperatures in the range of −40°C to +70°C and should not be used outside this range.
- Φ Installation shall be carried out in accordance with the applicable code of practice by suitably trained personnel.

- The equipment is not intended to be repaired by the user. Repair of this equipment shall be carried out in accordance with the applicable code of practice.

- If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

  Aggressive Substances - e.g. acidic liquids or gases that may attack metals or solvents that may affect polymeric materials.

  Suitable Precautions- e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

- Certification marking as detailed in LB0010C.

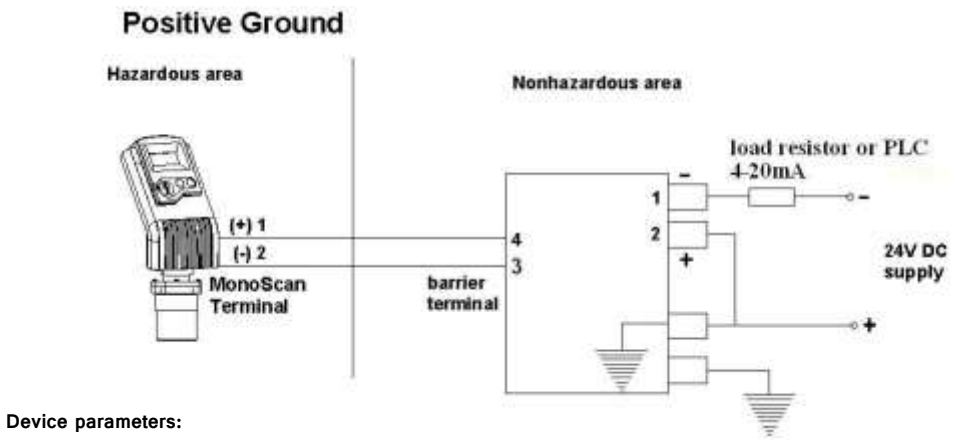


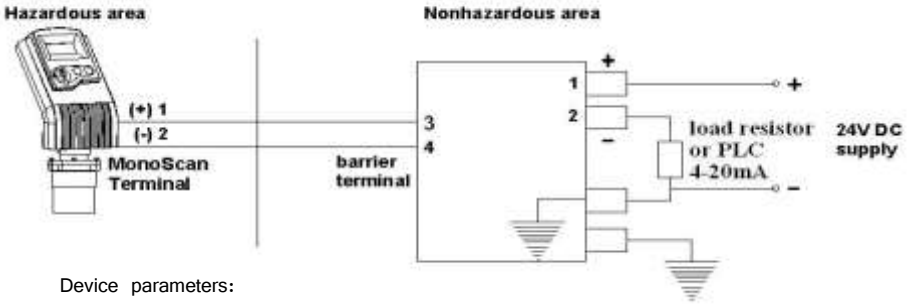
Figure 9: Intrinsically Safe Positive Ground Connection

Producer	Zener Barrier Part Number	Intrinsic Safety Approval	Interconnection		Series resistance
			Barrier Terminal	MonoScan Terminal	
MTL	7728-	CENELAC, CSA, ATEX, FM, UL	3 4	1 2	333Ω
STAHL	9001/00-280-085-101	CENELAC, CSA, ATEX, FM, UL	3 4	1 2	375Ω

NOTES:

MonoScan (IS) is approved for hazardous area installation with the above specified barriers. Consult factory for a detailed information regarding usage of alternative barriers.

Negative Ground



Device parameters:
Vi = 28 V
Ii = 93mA
Pi = 1.71 W
Ci = 0 pF
Li = 0uH

ATEX: EX ia IIC T4
Ta = +70°C; Type 4

Voltage to the barriers should not exceed 250V.

Figure 10: Intrinsically Safe Negative Ground Connection

Producer	Zener Barrier Part Number	Intrinsic Safety Approval	Interconnection		Series resistance
			Barrier Terminal	MonoScan Terminal	
MTL	7787+	CENELAC, CSA, ATEX, FM, UL	3 4	1 2	333Ω
STAHL	9001/01-280-085-101	CENELAC, CSA, ATEX, FM, UL	3 4	1 2	375Ω

NOTE:

MonoScan (IS) is approved for hazardous area installation with the above specified barriers. Consult factory for a detailed information regarding usage of alternative barriers.

Power Supply and Load Resistance Recommendations

The following table specifies the recommended power supply for MonoScan (Intrinsically Safe).

Power Supply Voltage	Minimum Resistance Value	Maximum Resistance Value
24 V	41 Ω	545 Ω
28 V	68 Ω	727 Ω

* Note: The resistance value is the total sum of the series resistor (for PLC resistance) and the barrier resistance and the lines resistance. The minimum voltage level on terminals should not be less than 12.0 VDC.

For any question before installation please consult with your distributor.
For a detailed connection diagram refer to Non-Intrinsically Safe Connections drawings.

NOTE:

Warning!

Explosion Hazard – Do not disconnect while circuit is live, unless the area is known to be Non-Hazardous.

Ripple/Noise Parameters Recommended for the Power Supply

The following ripple/noise parameters are recommended for the power supply:

Φ 100 mvp-p max

Power Supply type recommendations

Φ Prefer a regulated switching power supply.

Φ A rectified power supply is not recommended.

Φ When powering by a battery, avoid the use of switching charger.

Feeding Via PLC

Φ Verify that the voltage level on the MonoScan terminals is at least 12.0 VDC.

Φ Check PLC specifications for grounding options.

Chapter 3

Setting Up and Calibrating MonoScan

This chapter explains how to set up and calibrate MonoScan for accurate measurement monitoring.

MonoScan is supplied with preprogrammed default settings, making it ready for immediate operation. There is no need to change the default settings, unless you wish to calibrate MonoScan for your specific requirements; however, it is recommended that you replace the default tank height value with the actual tank height, as described on page 32. When using MonoScan, the tank height is calculated as the distance from the surface of the sensor to the bottom of the tank. You should enter this value whenever tank height is required. (For flow measurement, enter the precise flume height.)

MonoScan contains eleven programs, referred to as functions, which enable you to change the default settings and calibrate MonoScan as required. These functions are accessed from a functions menu. The functions **Pr01**, **Pr02**, **Pr04** and **Pr05** are the most important to ensure correct usage of your MonoScan device (with the addition of **Pr00** if using a MonoScan O model). Function **Pr03** may be used if there are interfering signals.

The remaining functions (**Pr06**, **Pr07, Pr08, Pr09 and Pr10**) enable you to customize MonoScan for your monitoring requirements or to restore factory default settings.

NOTE:

Some functions are only relevant for particular MonoScan models.

The diagram below shows the functions available in the functions menus for the MonoScan O, L and S models.

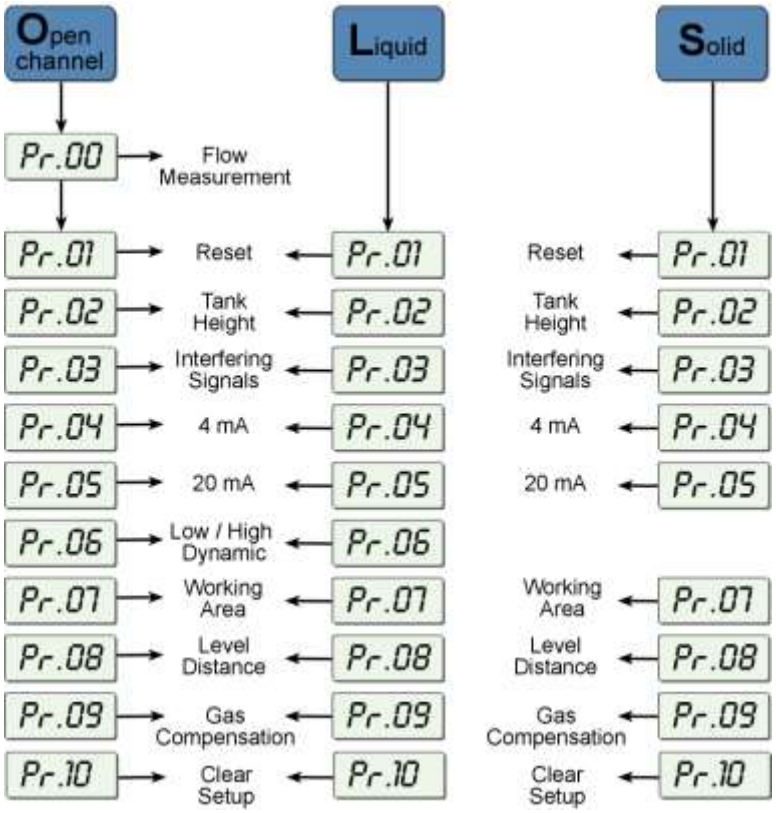


Figure 11: MonoScan Functions Menus

Setting flow measurement parameters (function **Pr00**) for the MonoScan Open Channels model is described in *Chapter 4, MonoScan Open Channels.* Setting parameters for all other functions and accessing the functions are described in this chapter.

Using MonoScan Functions

The LCD display screen, functioning in "normal" mode, provides continuously updated measurement readings. The display screen is also used to view MonoScan's menu options, function settings and data values, accessed by using MonoScan's function buttons.

The picture below shows the upper part of MonoScan:

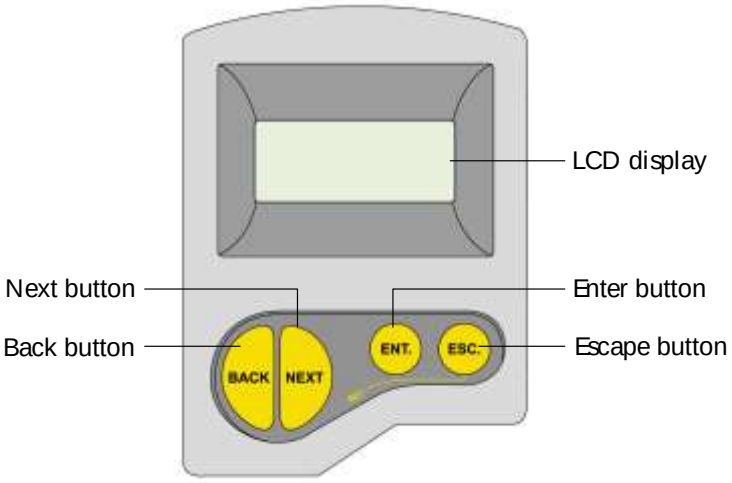
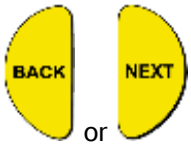


Figure 12: MonoScan Display and Function Buttons

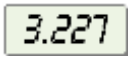
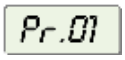
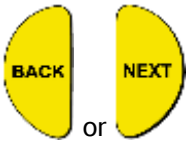
The function buttons are used to perform various operations, summarized in the following table.

Button	Uses Include:
	Φ Accessing the functions menu (when pressed simultaneously with) Φ Selecting functions Φ Progressing to the next step of a function Φ Moving from left to right between displayed digits (see note on the following page) Φ Saving changes to data
	Φ Accessing the functions menu (when pressed simultaneously with) Φ Exiting the functions menu to restore the distance reading Φ Moving from right to left between displayed digits (see note on following page) Φ Exiting a function without saving changes Φ Clearing error messages
 or	Φ Scrolling through the functions menu Φ Scrolling through available data values in functions Φ **NEXT** button only: Recording interfering signals (see page 342)

NOTE:

Within some functions, the digits in the displayed value can be individually modified. This is indicated by a flashing digit (flashing digits are shown in gray in the display illustrations, for example,). In this case, the **ENT** and **ESC** buttons enable you to move between the digits. Each flashing digit can be modified using the **BACK** and **NEXT** buttons.

➢ To start up MonoScan and access the functions:

	Press/Action	Display	Explanation
⇨	Connect MonoScan to power supply		Temporary display while MonoScan takes a reading.
⇨	After a brief pause	For example: 	Distance reading.
⇨	and (simultaneously)	For example: 	Enters the functions menu.
⇨			Used to search for the required menu selection.
⇨			Accesses the selected function.

NOTES:

If an error message Err appears, press the **ESC** button to return to the main menu.

Values are displayed in meters and centimeters or feet and inches, according to the version of MonoScan.

Pr.01 Resetting MonoScan

The **PR01** function enables you to do a reset, refreshing the MonoScan measurement reading. (Other saved function settings are not changed.) After resetting, the actual reading is displayed on the LCD, and MonoScan begins to scan (same as in turning the unit on/off).

The reset function may sometimes be required after changing one of the MonoScan's settings or after receiving an error message.

NOTE:

During reset the MonoScan will display 8.8.8.8 followed by 22mA current output.

➢ **To reset MonoScan:**

	Press/Action	Display	Explanation
⇨	ESC. and ENT. (simultaneously)	Pr.01	Required menu selection.
⇨	ENT.	8.8.8.8	Temporary display while MonoScan takes reading.
⇨	After a brief pause	For example, 3.227	Distance reading.
⇨	ESC. and ENT. (simultaneously)		Returns to the functions menu.

Pr.02 Entering Distance to Empty Level (Tank Height)

The **Pr02** function enables you to enter distance from sensor face to empty level. When sensor face coincides with tank top, you may enter the height of the tank. Default value is the highest value in the relevant measurement range for your model. If you enter a value that exceeds this highest value, the **Err** error message is displayed and the value is not saved.

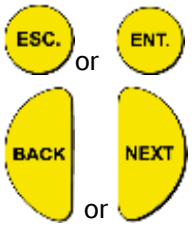
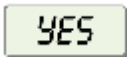
NOTES:

For flow measurement, enter the precise distance from the sensor to the bottom of the flume.

The first digit can be modified to read between 0 and 1 for metric units or between 0 and 5 for feet units.

For Shift Blocking Distance refer to Chapter 3.

⇨		Pr.02	Required menu selection.
⇨	ENT.	H oo	Indicates the measurement unit, either meters or feet (according to the MonoScan version).
⇨	ENT.	For example 15.00	Displays last saved tank height or default value (maximum value in range).

	Press/Action	Display	Explanation
⇨			Used to enter a new value, as described on page 320.
⇨			To save the new value, press when standing on the far-right digit. After **YES** is displayed, the display returns to the functions menu.
	OR		
⇨			To return to the main menu without saving, press when standing on the far-left digit.

Pr.03 Defining Interfering Signals

The **Pr03** function enables you to locate and store up to six interfering signals (false echoes) in the MonoScan memory, to avoid having obstructions such as a tank agitator or sidewall interfere with the measurement of the contents. Defining interfering signals is done while the tank is empty.

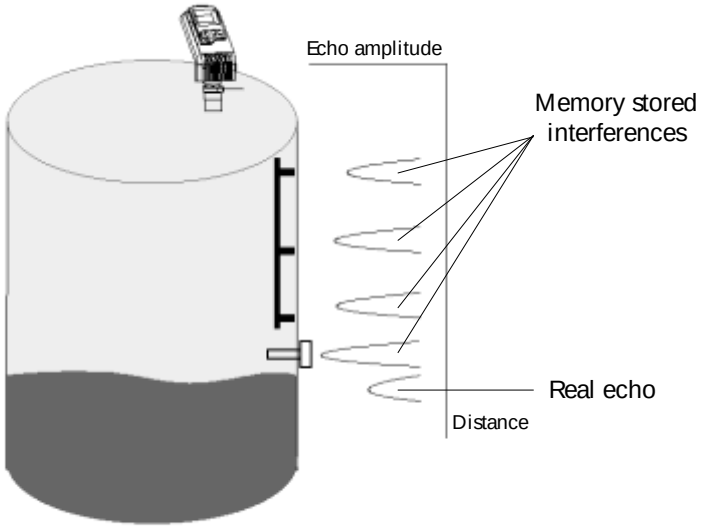


Figure 13: Scan Distance Process

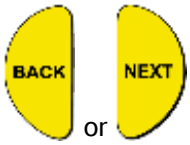
Each reading (scan distance) taken using the **Pr03** function is stored as an interfering signal, until a reading is achieved that indicates the real echo. If six interfering signals are already stored, the following values will not be saved.

NOTES:

The reading of the actual target height may not be exact, for example, a target height of 6 m may give a reading in the range 5.98 - 6.02.

The displayed values are in distance units.

➢ To define interfering signals:

	Press/Action	Display	Explanation
⇨		Pr.03	Required menu selection.
⇨	 or	SrCH CLr	Select *Search* to locate acoustic interferences, or *Clear* to delete stored interferences.
⇨		YES	Displayed after the selection for 3 seconds and then the menu returns to Pr.03.
⇨		0.0.5.E	Temporary display while MonoScan searches for interfering signals.
⇨	After a brief pause	For example, 3.227	Depth to interfering signal.
⇨			Saves the interfering signal, then searches again and displays the next reading. Continue to press this button to save up to six interference readings.

	Press/Action	Display	Explanation
⇨		For example, 6.000	Actual target height reading indicates that there are no more interfering signals.
⇨	ENT.	YES	Saves the entered values.

NOTES:

If the value represents an interference or false echo or false target - press NEXT. If the value represents the real target, real distance – press ENT.

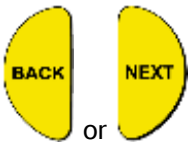
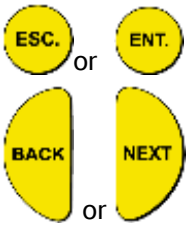
Pr.04 Configuring 4mA Current Output

Pr04 function enables you to enter values to be used as the 4mA mark for remote monitoring. You can define the 4mA values for Level, Distance or Flow measurements. The measurement values types should be defined in Pr.04 (described on page 386). These definitions will be applicable as well for the 20mA values defined in Pr.05. Distance and level measurements can be defined for both Solid and Liquid MonoScan models. For MonoScan Flow models, distance, level and flow measurements can be defined.

To set 4mA and 20mA for *level* measurements you should configure **Pr04** and **Pr05** for level values.
For example, if we measure a tank with tank height configured for 5 meters, the 4mA values will represent zero tank level and 20mA values will represent full tank level. Therefore, the value entered in **Pr04** will be 0.000m and the value entered in **Pr05** will be 5.000m.

When setting 4mA and 20mA for *distance* measurements, 4mA values will represent the minimal distance between the surface of the target and the sensor and 20mA values will represent the maximal distance between the sensor and the surface of the target. Therefore, 4mA represents the full part of the tank and 20mA represents the empty part of the tank.

➢ To enter 4mA values:

	Press/Action	Display	Explanation
⇨		Pr.04	Required menu selection.
⇨		For example, L000	Select 4mA (and 20mA) values format: Level (L000), Distance (d000) and Flow (F000).
⇨		C004	
⇨		For example 00.00	Last saved 4mA level or zero default value.
⇨			Used to enter a new value, as described on page 320.

	Press/Action	Display	Explanation
⇨	ENT.	YES	To save the new value, press ENT. when standing on the far-right digit. After **YES** is displayed, the display returns to the functions menu.
⇨	ESC.		To return to the main menu without saving, press ESC. when standing on the far-left digit.

NOTES:

The values for 4mA and 20mA must be different; otherwise an **Err** error message is displayed.
The values for 4mA and 20mA should not be greater than the value used for the tank height (**Pr02**). Because of the dead-zone, the distance between the sensor and the surface of the target at its highest level should be a minimum of
0.25 m/0.8 ft for Short-Range models, or 0.6 m/1.96 ft for Standard-Range models.
The first digit of the 4mA value can be modified to read between 0 and 1 for metric units or between 0 and 5 for U.S. Standard units.
After accessing the **Pr04** function, the unit generates a fixed current of 22mA on the 4-20mA line. When the MonoScan reverts to regular scanning mode, the 4-20mA line returns to regular functioning.

The default values for 4mA and 20mA in Solid and Liquid MonoScan models are level.

The default values for 4mA and 20mA in Flow MonoScan models are flow.

When changing from one measurement mode to another, the measurement units will be changed automatically (for example, when changing from level mode to flow mode, the units will change from meters to M^3/H.)

The measurement mode selected for the 4-20mA values will not influence the measurement mode selected for the display (**Pr.08**).

In case of power rest, measurement configuration (level, distance, flow) will be saved according to the unit's last configuration.

Pr.05 Configuring 20mA Current Output

The **Pr05** function enables you to enter values to be used as the 20mA mark for remote monitoring.

➢ **To enter 20mA values:**

	Press/Action	Display	Explanation
⇨		Pr.05	Required menu selection.
⇨	ENT.	C020	
⇨	ENT.	For example 05.00	Last saved 20mA level or default value (maximum value in range).
⇨	ESC. or ENT. / BACK or NEXT		Used to enter a new value, as described on page 320.
⇨	ENT.	YES	To save the new value, press ENT. when standing on the far-right digit. After **YES** is displayed, the display returns to the functions menu.
	OR		

	Press/Action	Display	Explanation
⇨	ESC.		To return to the main menu without saving, press ESC. when standing on the far-left digit.

NOTES:

Type of measurement (level, distance, flow) selected in Pr.04 is also applicable for Pr.05.

The values for 4mA and 20mA must be different; otherwise an **Err** error message is displayed.

The values for 4mA and 20mA should not be higher than the value used for the tank height (**Pr02**).

The first digit of the 20mA value can be modified to read between 0 and 1 for metric units or between 0 and 5 for U.S. Standard units.

After accessing the **Pr05** function, the unit generates a fixed current of 22mA on the 4-20mA line. When the MonoScan reverts to regular scanning mode, the 4-20mA line returns to regular functioning.

Please refer to chapter 5 *Troubleshooting* for 20mA error indications.

Pr.06 Selecting Low/High Dynamic Speed

(Open Channels and Liquid Only)

The **Pr06** function enables you to choose the required speed level. There are two settings available:

- **SE 0:** Low dynamic mode (default setting). This mode provides slower readings with a greater degree of accuracy (Rate of up to 80 cm/31in per min').
- **Fail Safe:** 10 minutes.
- **SE 1:** High dynamic mode. This mode provides faster readings but with less precision (Rate of up to 100 cm/39 in per min').
- **Fail Safe**: 3 minutes.

NOTE:

Fail – Safe timer determines the waiting period from an echo loss till a transmission of an error signal.

➢ **To select the speed mode:**

	Press/Action	Display	Explanation
⇨		Pr.06	Required menu selection.
⇨	ENT.	SE0 or SE1	Displays the current operation mode setting.
⇨	BACK or NEXT		Used to toggle between the operation modes.
⇨	ENT.	YES	Saves the selected operation mode.

Pr.07 Defining Working Area

The **Pr07** function allows you to add distance range that exceeds the tank's height, thus enabling accurate readings of complicated tank shapes with conic ending. This may be required when the vessel has a conical bottom shape which is causing false echoes and consequently faulty measurements. The minimal value can be the entered tank height and the maximal value can be double the value of the entered tank height (limited to 15m/49ft). The default setting is the entered tank height.

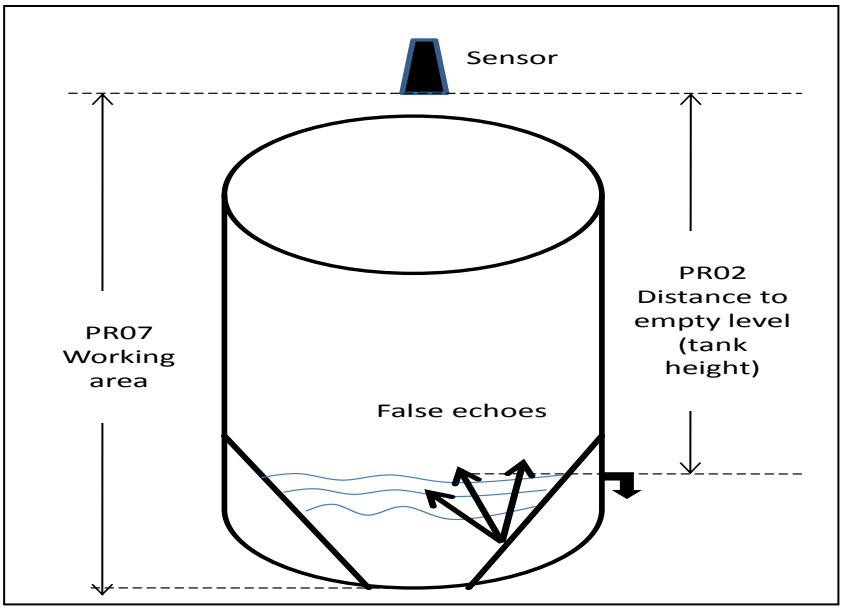


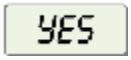
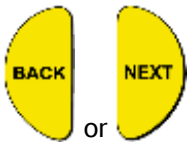
Figure 14: Defining Working Area

NOTE:

It is recommended to use the **Pr.07** function only in ***Distance*** mode.

➢ To define a Working Area:

	Press/Action	Display	Explanation
⇨		Pr.07	Required menu selection.
⇨	ENT.	ArEA	Displayed when entering the function.
⇨	ENT.	for example: 05.00	Displays the value last saved in the tank height (default). The entered value should not be more than double the tank height and should not exceed the MonoScan's maximum measuring range (15m/49ft).
⇨	ESC. or ENT. / BACK or NEXT		Used to enter a new value, as described on page 320.

	Press/Action	Display	Explanation
⇨			Saves the entered value.
⇨			Used to move on to the next function.

Pr.08 Selecting Distance or Level Display

The **Pr08** function enables you to choose whether MonoScan displays either distance or level measurements. There are two settings available:

- **d000:** Distance mode (default setting): In this mode, MonoScan displays the distance from the sensor to the surface of the contents.
- **L000:** Level mode: In this mode, MonoScan displays the level of the contents from the bottom of the tank.

NOTE:

The measurement mode selected for the display will not influence the measurement mode selected for the 4-20mA values (**Pr.04**).

➢ **To select distance or level display:**

	Press/Action	Display	Explanation
⇨		Pr.08	Required menu selection.
⇨	ENT.	dDDD or LDDD	Displays the current distance/level mode setting.
⇨	BACK or NEXT		Used to toggle between the modes.
⇨	ENT.	YES	Saves the selected mode.

Pr.09 Entering factor for Gas Compensation

Function Pr.09 enables you to compensate for sound velocity changes in different types of gasses. You can enter the appropriate factor for each type of gas listed on the 'Gas Factor Table' (Appendix A). For example the sound velocity in air (in room temperature) is 343 m/sec and for Methane (C_{h4}) 445.82 m/sec, therefore a factor of 445.82/343 = 1.29 should be entered to compensate for this type of gas. This factor will compensate in cases when the gas compound consists on 100% Methane. In case the gas is not pure, the sound velocity cannot be estimated and therefore a minor deviation could appear. It is recommended to use a reference measurement indicator (using a tape or other measuring device) and compare the measurement results between the MonoScan and the reference measurement indicator. If the result is correct, press ENT. If the accuracy deviation is higher than expected, continue and calibrate the factor to meet the gas maintained in the vessel. For example, if the gas composition consists of water and gas you can add +/- 0.01 to the factor figure already entered, to meet your application requirements.

The 'Gas Factor Table' (page 82) supports up to 33 different types of gasses.

➢ To enter a gas compensation factor:

	Press/Action	Display	Explanation
⇨		Pr.09	Required menu selection.
⇨	ENT.	CmnP	Default screen.
⇨	ENT.	01.00	Default value.
⇨	BACK or NEXT ESC. or ENT.	00.71	Choose a factor from the 'Gas Factor Table' (Appendix A, Page 82).
		For example:	This is the factor for Ethanol.
⇨	ENT.	YES	Saves the chosen gas factor.

NOTES:

Repeat this procedure if the measurement results differ from the actual material level measured with a reference tape (or other reference measurement method). Add or reduce 0.01 to calibrate the factor figure already entered.

Updated on-screen results may take a few seconds to appear.

Pr.10 Restoring the Default Settings

The **Pr10** function allows clearing all user-defined settings and reverting to the default factory settings.

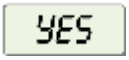
Default factory settings are:

Pr.00: GPM 1U01 or M³/Hr 1E01
Pr.02: Sbd 00.00, E000, Tank Height =default
Pr.03: Resets all interfering signals
Pr.04: Solid/Liquid device L000, 00.00 or
Flow device F000, 00.00
Pr.05: Solid/Liquid device Tank Height = Pr.02
Flow device 55500 M³/Hr or 244400 GPM
Pr.06: SE 0 (Liquid & Flow)
Pr.07: Tank Height = Pr.02
Pr.08: d000
Pr.09: 01.00

NOTE:
If you decide not to revert to the default settings, press **ESC** when **CLCL** is displayed. A redo option is not available when **ENT** has been pressed.

➢ To restore the default settings:

	Press/Action	Display	Explanation
⇨		Pr.10	Required menu selection.
⇨	ENT.	CLCL	

	Press/Action	Display	Explanation
⇨			Reverts all settings to default factory settings.

Shifting the Blocking Distance

This function enables you to define an area in which measurement results would be ignored. This option is applicable for installations requiring extension pipes or nuzzles positioned above the material level. This area should approx, fit the pipe/nuzzle length to eliminate false echoes and to provide accurate and stable measurement readings.

➢ **To shift the blocking distance:**

Follow the directions given for *Entering the Tank Height Value*, page 320. Instead of entering the tank height value, enter **00.01**, and continue as follows:

	Press/Action	Display	Explanation
⇨		00.01	Insert this code to enter the Blocking Distance area.
⇨	ENT.	Sbd	This message will flash for a few seconds, indicating an entry to the Blocking Distance area.
⇨	ESC. or ENT. or BACK or NEXT	For example, 0.750	Shifts the blocking distance to 0.75m (2.46 ft).

	Press/Action	Display	Explanation
⇨		YES	Saves this entry and returns to Pr.02.

NOTES:

Shifting of the Blocking Distance is limited to 1.5m/4.9ft. The value entered to the SBD incorporates the Dead Zone Value.

Pr.10 (Clear) reverts the blocking distance to its default.

Echo received from the defined Blocking Distance area will be ignored by the MonoScan and the measurement result will be based on the next echo.

When installing via extension pipe, it is recommended to keep approx. 10cm (4") gap between the shortest distance to target (maximal level) and the lower pipe edge. Set the SBD length to a value that equals to the distance from the sensor's lower edge to pipe's lower edge plus 5 cm (2"), in order to avoid second harmony interference.

Verifying the Version Number

In addition to the functions described, you can verify the MonoScan version number.

➢ **To verify the MonoScan version number:**

Follow the directions given for *Entering the Tank Height Value*, page 320. Instead of entering the tank height value, enter **00.17**, and continue as follows:

	Press/Action	Display	Explanation
⇨	ENT.	YES	
⇨	After a brief pause	Addr	

	Press/Action	Display	Explanation
⇨			Displays the version number.

Defining 22mA Signal Error Messages

MonoScan allows you to define if the following signal error indications: Near Zone and Lost Echo, will be active when the current output reaches 22mA. The MonoScan default setting enables 22mA analog current and error messages to appear on its LCD display.

Near Zone - whenever the distance is below the defined Dead Zone (depending on the MonoScan model you are using) F.F.F.F message will be displayed on the LCD.

Lost Echo - whenever the echo is lost, or in cases when the measurement results exceed the tank height or when a returned echo is not received E.E.E.E message will be displayed on the MonoScan's LCD.

You can choose to enable or disable these error messages and 22mA analog signal as follows:

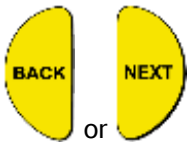
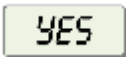
Φ **d000:** Disable

Φ **E000:** Enable (default setting)

Refer to Chapter 5, *Troubleshooting* for a detailed list of the 22mA signal error messages.

➢ To disable/enable 22mA signal error in the MonoScan:

Follow the directions given for *Entering the Tank Height Value*, page 320. Instead of entering the tank height value, enter **00.16**, and continue as follows:

	Press/Action	Display	Explanation
⇨			Choose disable
⇨			Used to toggle between the modes.
			Disables the 22mA error messages

NOTE:

When the error signals are disabled the following current outputs will be displayed:
If the MonoScan is set to Level or Flow then F.F.F.F will indicate 20mA and E.E.E.E will indicate 4mA.
If the MonoScan is set to Distance then F.F.F.F will indicate 4mA and E.E.E.E will indicate 20mA.

Chapter 4

MonoScan Open Channels

This section describes how to set flow measurement parameters for open channels, and explains the flume/weir codes methodology used when setting up flow measurements.

Pr.00 Selecting the Flow Measurement Settings

The **Pr00** function enables you to select one of the preset flumes/weirs settings for flow measurements. This function is available only in MonoScan O models.

When setting flow measurement parameters in the **Pr00** function, the flume/weir type value (X) is entered first, followed by the letter (U) or (E) that represents either American (USA) or European standard flume/weir. The code value (YY) represents the appropriate flume/weir dimensions in the following format: XU.FF. The open channel types and codes are described in *Open Channels Flow Measurements*, page 57.

NOTES:

Refer to *Chapter 3, Setting Up and Calibrating MonoScan*, for an explanation of accessing and using the MonoScan functions menu.

All flow measurement values are displayed divided by ***1000***.

➢ To select the flow measurement settings:

	Press/Action	Display	Explanation
⇨		Pr.00	Required menu selection.
⇨	ENT.	For example: GPnn	Indicates the measurement unit for flow, either GPM (in American standard) or M^3 (in European standard) (according to the MonoScan version).
⇨	ENT.	1U.01	Displays last saved flow measurement setting or default value, with first digit flashing (U – American standard and E – European standard).
⇨	BACK or NEXT		Use to select a new type value (X).
⇨	ENT.	1U.01	Last two digits of the display flash.
⇨	BACK or NEXT		Use to select a new flume/weir length code (YY).
⇨	ENT.	YES	Selected values are saved.

Open Channels Flow Measurements

The flume/weir type code methodology used when setting up open channels is based on three digits: **X(U/E)YY**

Where:

X refers to the particular flume/weir type

U/E refers to either American or European standard flumes/weirs

YY refers to the specific flume/weir dimensions

The types of flumes/weirs are available in European standard and American standard. Default setting is European standard. When working in European standard the default flow measurement units will be **M^3/Hr**, and in American standard the default flow measurement units will be **G.P.M** .

Flume/Weir Types

This is the first value (X) entered for the **Pr00** function. The following flume/weir types are available both in European and American standard:

Type (X)	European Standard Pages 59 - 68	American Standard Pages 69 - 76
1	Rectangular Suppressed Sharp-Crested Weir, Page 59	Rectangular Suppressed Sharp-Crested Weir, Page 69
2	Rectangular Contracted Sharp-Crested Weir, Page 60	Rectangular Contracted Sharp-Crested Weir, Page 70
3	Trapezoidal (Cipolletti) Sharp-Crested Weir, Page 66	Trapezoidal (Cipolletti) Sharp-Crested Weir, Page 71
4	V-notch (Triangular) Sharp-Crested Weir, Page 62	V-notch (Triangular) Sharp-Crested Weir, Page 72
5	Khafagi-Venturi Flume, Page 63	Parshall Flume, Page 73
6	Parshall Flume, Page 64	Palmer Bowlus Flume Trapezoidal Throat Cross-Selection, Page 74
7	Palmer Bowlus Flume Trapezoidal Throat Cross-Selection, Page 65	H Flume, Page 75
8	H Flume, Page 66	Leopold-Lagco Flume, Page 76
9	Neyrpic Venturi Flume/Long-Base Weir, Page 67, 68	

Flumes/Weirs - European Standard

Rectangular Suppressed Sharp-Crested Weir (Type 1)

Code (YY)	Crest Length (cm)
01	20
02	40
03	60
04	80
05	100
06	150
07	200
08	300

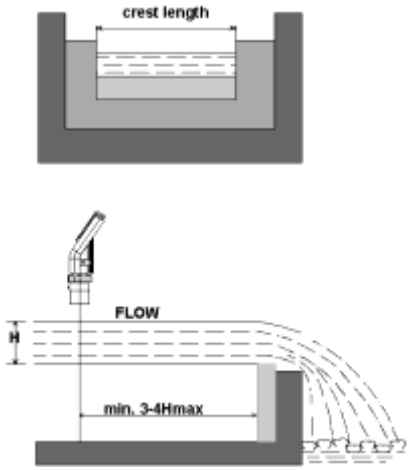


Figure 14: Rectangular Suppressed Sharp-Crested Weir

Rectangular Contracted Sharp-Crested Weir (Type 2)

Code (YY)	Crest Length (cm)
01	20
02	30
03	40
04	50
05	60
06	80
07	100
08	150

09	200
10	300

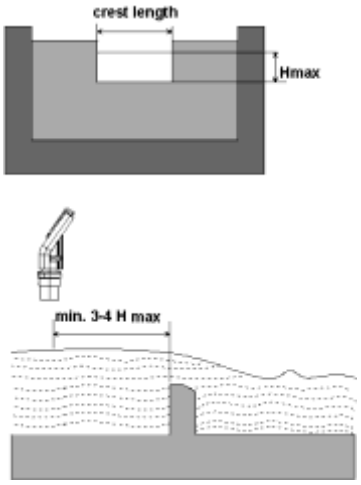


Figure 15: Rectangular Contracted Sharp-Crested Weir

Trapezoidal (Cipolletti) Sharp-Crested Weir (Type 3)

Code (YY)	Crest Length (cm)
01	30
02	45
03	60
04	80
05	100

06	150
07	200
08	300

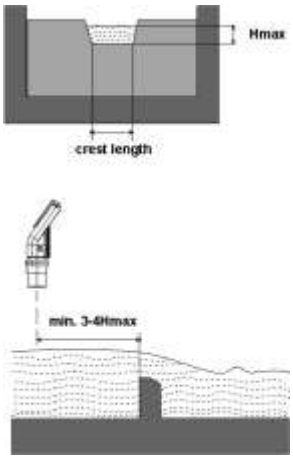


Figure 16: Trapezoidal (Cipolletti) Sharp-Crested Weir

V-Notch (Triangular) Sharp-Crested Weir (Type 4)

Code (YY)	V-Notch Angle (°)
01	90
02	60
03	53.8
04	45
05	30
06	28.4
07	22.5
British Standard	
08	90
09	45
10	22.5

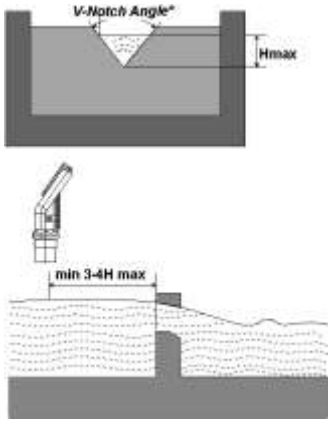


Figure 17: V-Notch (Triangular) Sharp-Crested Weir

Khafagi-Venturi Flume (Type 5)

Code (YY)	Flume Type	b0 (cm)
01	QV 302	12
02	QV 303	30
03	QV 304	40
04	QV 305	50
05	QV 306	60
06	QV 308	80
07	QV 310	100
08	QV 313	130
09	QV 316	160

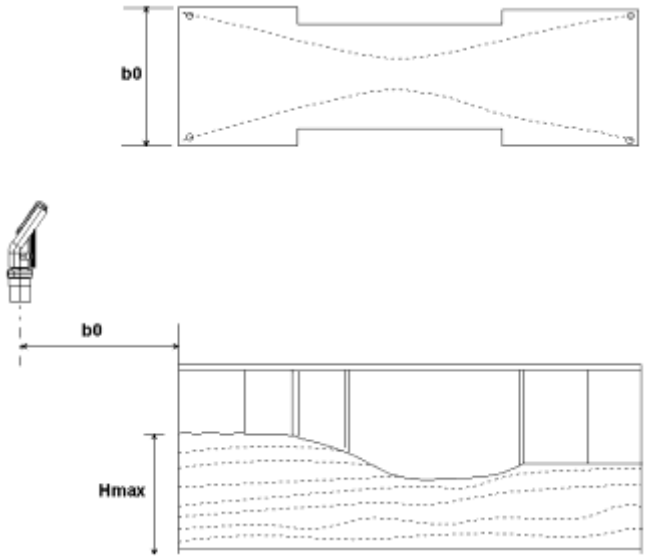


Figure 18: Khafagi-Venturi Flume

Parshall Flume (Type 6)

Code (YY)	Throat Width (in)
01	1
02	2
03	3
04	6
05	9
06	12
07	18

Code (YY)	Throat Width (in)
11	60
12	72
13	96
14	120
15	144

08	24
09	36
10	48

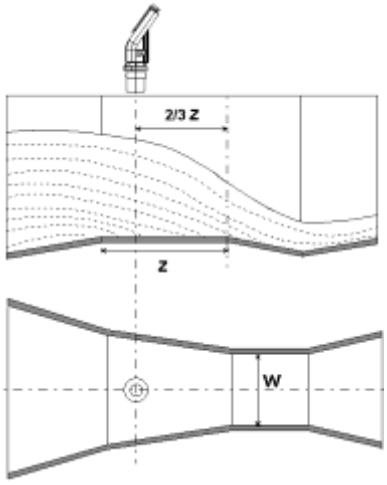


Figure 9: Parshall Flume

Palmer Bowlus Flume Trapezoidal Throat Cross-Selection (Type 7)

Code (YY)	Conduit Diameter (in) D
01	6
02	8
03	10

04	12
05	15
06	18
07	21
08	24
09	27
10	30

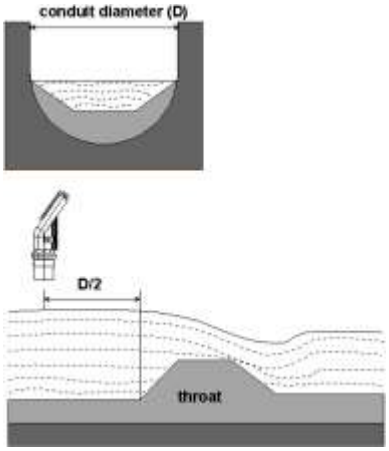


Figure 10: Palmer Bowlus Flume Trapezoidal Throat Cross-Selection

H Flume (Type 8)

Code (YY)	Flume Size (ft)	Measurement Point (cm)
01	0.5	5

02	0.75	7
03	1	9
04	1.5	14
05	2	18
06	2.5	23
07	3	28
08	4.5	41

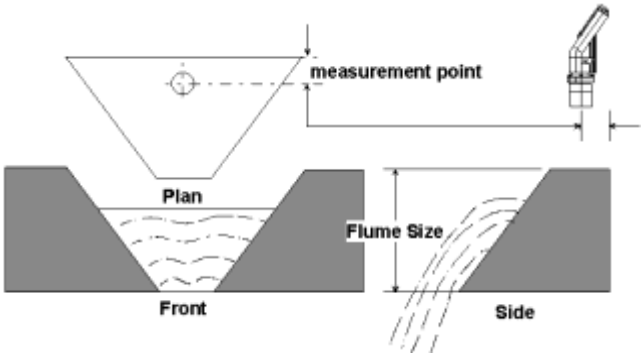


Figure 22: H Flume

Neyrpic Venturi Flume/Long-Base Weir (Type 9)

Neyrpic Venturi Flume

Code (YY)	Venturi Flume Type
01	1253AX
02	1253AY
03	1253AZ
04	1253A
05	1253B
06	1253C
07	1253D
08	1253E
09	1253F

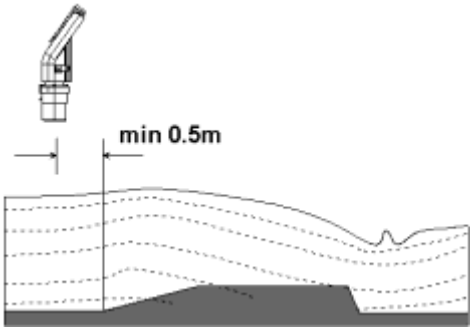


Figure 23: Neyrpic Venturi Flume

Long-Base Weir

Code (YY)	Long-Base Weir Type
10	1245A
11	1245B
12	1245C
13	1245D

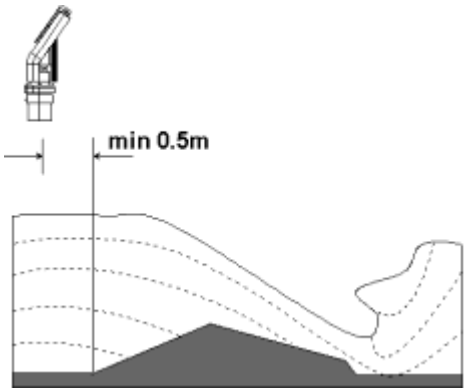


Figure 11: Long-Base Weir

Flumes/Weirs – American Standard

Rectangular Suppressed Sharp-Crested Weir (Type 1)

Code (YY)	Crest Length (in)
01	12.00
02	18.00
03	24.00
04	30.00
05	36.00
06	48.00
07	60.00
08	72.00
09	96.00

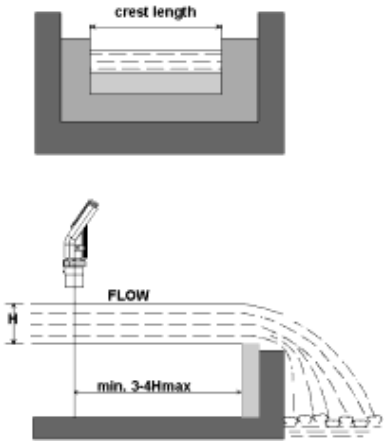


Figure 25: Rectangular Suppressed Sharp-Crested Weir

Rectangular Contracted Sharp-Crested Weir (Type 2)

Code (YY)	Crest Length (in)
01	12.00
02	18.00
03	24.00
04	30.00
05	36.00
06	48.00
07	60.00
08	72.00

09	96.00

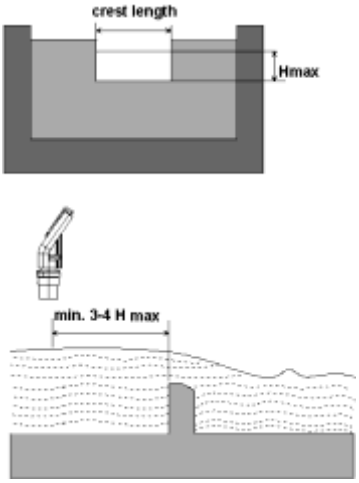


Figure 26: Rectangular Contracted Sharp-Crested Weir

Trapezoidal (Cipolletti) Sharp-Crested Weir (Type 3)

Code (YY)	Crest Length (in)
01	12.00
02	18.00
03	24.00
04	30.00
05	36.00
06	48.00

07	60.00
08	72.00
09	96.00

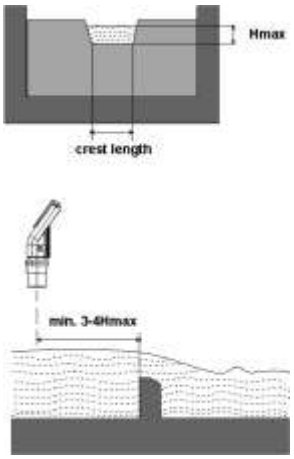


Figure 27: Trapezoidal (Cipolletti) Sharp-Crested Weir

V-Notch (Triangular) Sharp-Crested Weir (Type 4)

Code (YY)	V-Notch Angle (^{o})
01	90
02	60
03	45
04	30
05	22.5

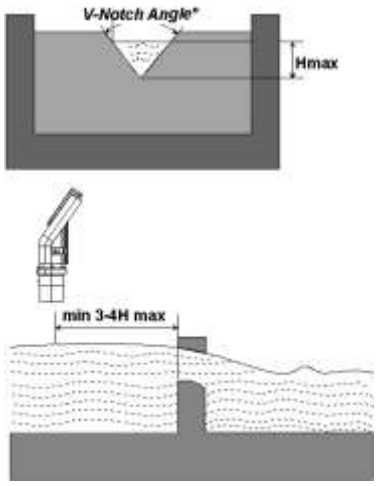


Figure 28: V-Notch (Triangular) Sharp-Crested Weir

Parshall Flume (Type 5)

Code (YY)	Throat Width (in)
01	1
02	2
03	3
04	6
05	9
06	12
07	18
08	24
09	30
10	36
11	48

Code (YY)	Throat Width (in)
12	60
13	72
14	96
15	120
16	144

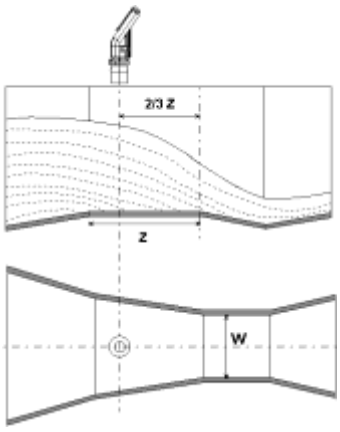


Figure 29: Parshall Flume

Palmer Bowlus Flume Trapezoidal Throat Cross-Selection (Type 6)

Code (YY)	Conduit Diameter (in) D
01	4
02	6
03	8
04	10
05	12
06	15
07	18
08	21
09	24
10	27

Code (YY)	Conduit Diameter (in) D
11	30
12	36
13	42
14	48
15	60
16	72

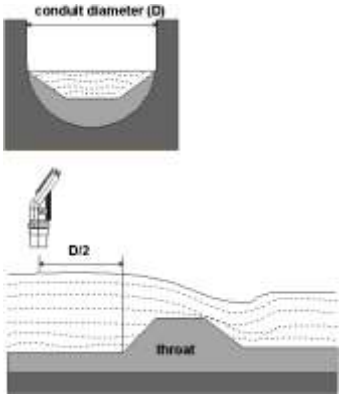


Figure 30: Palmer Bowlus Flume Trapezoidal Throat Cross-Selection

H Flume (Type 7)

Code (YY)	Flume Size (in)	Measurement Point (in)
01	6	1.96
02	9	2.75
03	12	3.54
04	18	5.51
05	24	7.08
06	30	9.05
07	36	11.02
08	54	16.14

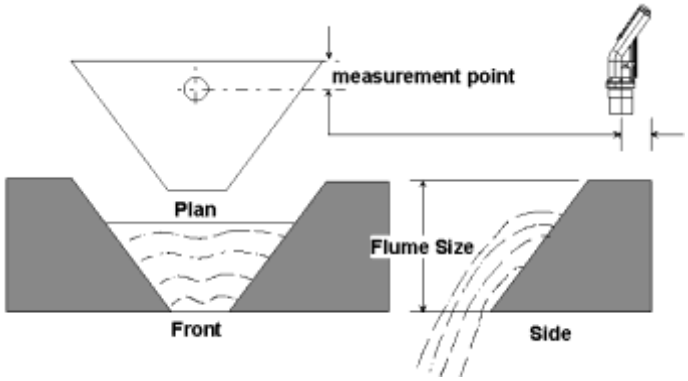


Figure 31: H Flume

Leopold-Lagco Flume (Type 8)

Code (YY)	Crest Length (in)
01	4
02	6
03	8
04	10
05	12
06	15
07	18
08	21
09	24
10	30

Code (YY)	Crest Length (in)
11	36
12	42
13	48
14	54
15	60
16	66
17	72

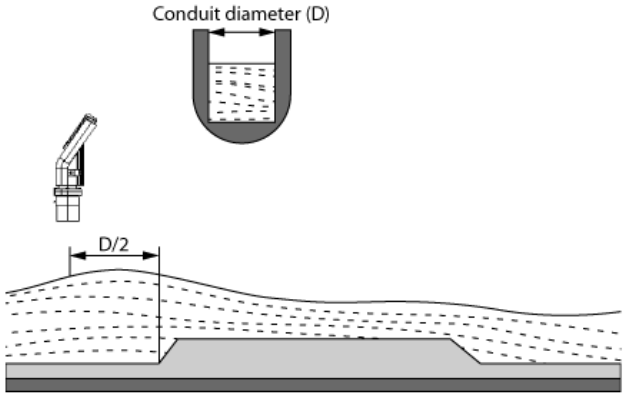


Figure 32: Leopold Lagco Flume

Chapter 5

Troubleshooting MonoScan

This chapter describes how to resolve problems that may occur when calibrating MonoScan, as follows:

Error	Description	Solution
EC11	1. Noise in area. (indicated by 22mA if the Error Signals are Enabled). 2. Inappropriate power supply/ no grounding.	1. Get away from noise source. 2. Check that the power supply is appropriate/ check grounding connection.
E555	Faulty power supply.	Make sure that the power supply corresponds with the specifications described in *Chapter 2, Installing MonoScan*. If the problem persists, replace the power supply.
5544	Sensor disconnected.	Contact the distributor for further instructions.
8818	Any combination of three 8s and one 1: Indicates an electrical shortage caused by depressing the buttons for too long.	Contact the manufacturer for further instructions.

Error	Description	Solution
8.8.8.8	Appears for several seconds after restarting the unit. If it is displayed for more than several seconds, it may be due to one of the following: Φ Power supply voltage is too low Φ Load resistor resistance is too high or unnecessary Φ A random pulse that causes the unit to automatically restart	Make sure that the power supply corresponds with the specifications described in *Chapter 2, Installing MonoScan*. If the problem persists, replace the power supply.
HHHH	Measurement value is greater than 9999.	Double check the unit configuration (Tank h, type of flume, 4-20mA settings.)
00.00	In Flow mode, appears when the entered tank height is incorrect.	Decrease the Tank Height value.

22mA Signal Error Messages

The following list of messages will appear on the display and coincides with a 22mA analog current error output signal (when the error signals messages are enables):

Error	Description	Solution
SS44	Sensor disconnected.	Contact the distributor for further instructions.
F.F.F.F	Near dead zone. (depends on the measurement definitions)	Move the sensor farther from the dead zone area.
E.E.E.E	Tank empty. (depends on the measurement definitions)	Check the level of material in the tank.
EC11	1. Noise in area. (indicated by 22mA if the Error Signals are Enabled). 2. Inappropriate power supply/ no grounding.	1. Get away from noise source. 2. Check that the power supply is appropriate/ check grounding connection.
ES55	Faulty power supply. (indicated by 22mA if the Error Signals	Make sure that the power supply corresponds with the

	are Enabled).	specifications described in *Chapter 2*, *Installing MonoScan*. If the problem persists, replace the power supply.

Appendix A
Gas Factor

The following table contains 33 different types of gasses and their factor for compensating the sound velocity:

Gas	Symbol	Factor
Acetic Acid	$C_2H_4O_2$	0.62
Acetone	C_3H_6O	0.63
Acetaldehyde	C_2H_4O	0.74
Acetyl Chloride	$C_2H_3C_1O$	0.54
Acetylene	C_2H_2	0.99
Ammonia	H_3N	1.26
Argon	Ar	0.92
Benzene	C_6H_6	0.53
Bromine	Br_2	0.41
Bromochlorodifluoromrthane	$CbrClF_2$	0.37
Butanone	$CH_3COCH_2CH_3$	0.56

Gas	Symbol	Factor
Carbon Dioxide	CO_2	0.77
Carbon Monoxide	CO	1.01
Carbon Tetrachloride	CCl_4	0.38
Chlorine	Cl_2	0.68
Dimethyl Ether	C_2h_6o	0.71
Ethane	C_2h_6	0.90
Ethanol	C_2h_6o	0.71
Ethylene	C_2h_4	0.95
Helium	He	2.93
Hydrogen	H_2	3.79
Hydrogen Sulfide	H_2S	0.89
Isopropyl Alcohol	C_3h_8o	0.62
Methane	CH_4	1.29
Methyl Hydrazine	Ch_6n_2	0.71
Neon	Ne	1.30
Nitrogen	N_2	1.01

Gas	Symbol	Factor
Nitromethane	CH_3NO_2	0.63
Oxygen	O_2	1.02
Propane	C_3H_8	0.72
Propanol	C_3H_8O	0.61
Tetrahydrofuran	C_4H_8O	0.57

Appendix B

Installation Tips

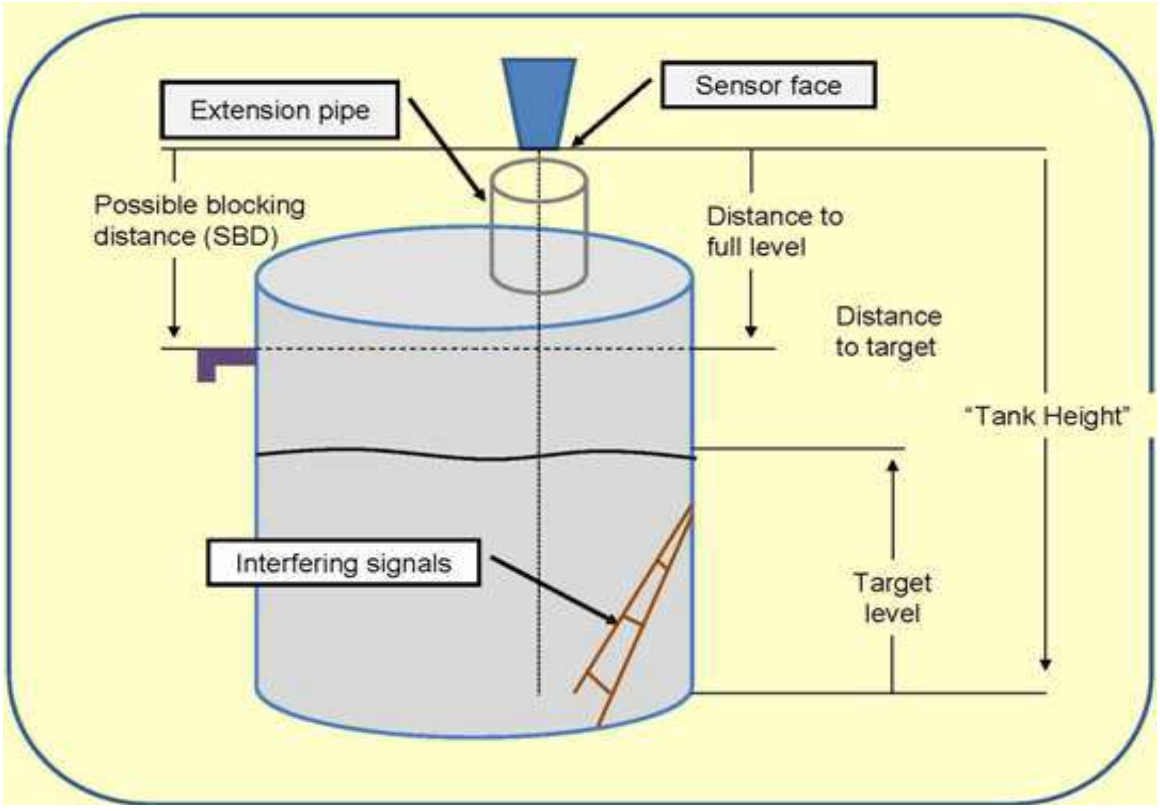
1） Choosing location		
Distance to tank walls	**MUST BE**	At least 50cm from walls + 10cm/1m range
Surface	**MUST BE**	Fixed on horizontal surface
Acoustic noises	**MUST BE**	Far away from acoustic noises and vibrations
Electrical interferences	**MUST BE**	Shielded away from power and sensor cables
Tank installation	**MUST BE**	Far away from tank inlets, outlets and physical obstacles
Sensor	**MUST BE**	Exactly perpendicular to the surface of the target
2） Handling Dead Zone		
Extension pipe（1）	**MUST BE**	Of at least 3” internal diameter and 50cm long from

		sensor low edge to pipe low edge)
Extension pipe(2)	**MUST BE**	With complete smooth interior surface
Extension pipe(3)	**MUST BE**	Installed with a flange and not protruding into the tank
3) Power Source		
Voltage	**MUST BE**	At least 12VDC on unit terminals
Battery	**MUST BE**	Rated higher than 12VDC due to normal voltage drop
Ripple and noise	**MUST BE**	Not exceeding 100mC
Type	**MUST BE**	Preferably regulated switching PS (avoid rectified PS)
Rechargeable supply	**MUST BE**	Non operational when switched to recharge
4) 2-wire Interface		
PLC Connection	**MUST BE**	As specified in the user manual, preferably grounded
Barrier	**MUST BE**	Connected in EX zones and grounded

5） Configuration		
Tank height, level and distance	**MUST BE**	Configured correctly
4-20 settings	**MUST BE**	Define （consider pipe extension）
5cm margin	**MUST BE**	Kept between pipe low edge and full level
Scan distance （1）	**MUST BE**	Preferably be executed in all applications
Scan distance （2）	**MUST BE**	Executed when the tank is empty
Scan distance （3）	**MUST BE**	Performed after the old stored data is cleared
SBD （1）	**MUST BE**	Set up in flange and extension pipe installations
SBD （2）	**MUST BE**	At least 5cm before pipe edge

Appendix C

Nomenclature



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